

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74HCT04AP, TC74HCT04AF

## Hex Inverter

The TC74HCT04A is a high speed CMOS INVERTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

This device may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. The inputs are compatible with TTL, NMOS and CMOS output voltage levels.

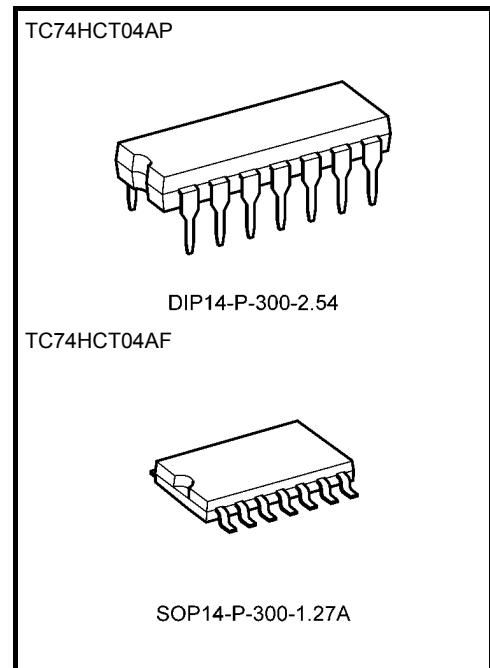
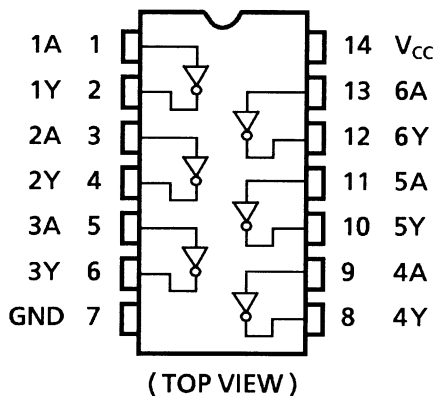
The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### Features

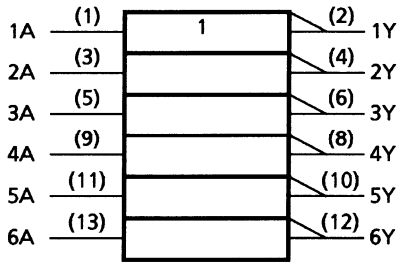
- High speed:  $t_{pd} = 8 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- Compatible with TTL outputs:  $V_{IH} = 2 \text{ V (min)}$   
 $V_{IL} = 0.8 \text{ V (max)}$
- Wide interfacing ability: LSTTL, NMOS, CMOS
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Pin and function compatible with 74LS04

### Pin Assignment



Weight	
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)

## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7	V
DC input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}C$ . From  $T_a = 65$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  shall be applied until 300 mW.

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	4.5 to 5.5	V
Input voltage	$V_{IN}$	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	$t_r, t_f$	0 to 500	ns

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		4.5 to 5.5	2.0	—	—	2.0	—	V
Low-level input voltage	V <sub>IL</sub>	—		4.5 to 5.5	—	—	0.8	—	0.8	V
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	4.5	4.4	4.5	—	4.4	—	V
			I <sub>OH</sub> = -4 mA	4.5	4.18	4.31	—	4.13	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	4.5	—	0.0	0.1	—	0.1	V
			I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	1.0	—	10.0	μA
	I <sub>C</sub>	Per input: V <sub>IN</sub> = 0.5 V or 2.4 V Other input: V <sub>CC</sub> or GND		5.5	—	—	2.0	—	2.9	mA

### AC Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t <sub>TLH</sub>	—	—	6	12	ns
	t <sub>THL</sub>	—	—	6	12	ns
Propagation delay time	t <sub>pLH</sub>	—	—	8	15	ns
	t <sub>pHL</sub>	—	—	8	15	ns

### AC Characteristics (C<sub>L</sub> = 50 pF, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Output transition time	t <sub>TLH</sub>	—		4.5	—	8	15	—	19	ns
	t <sub>THL</sub>	—		5.5	—	7	13	—	16	
Propagation delay time	t <sub>pLH</sub>	—		4.5	—	11	18	—	23	ns
	t <sub>pHL</sub>	—		5.5	—	9	16	—	20	
Input capacitance	C <sub>IN</sub>	—		—	—	5	10	—	10	pF
Power dissipation capacitance	C <sub>PD</sub> (Note)	—		—	—	20	—	—	—	pF

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

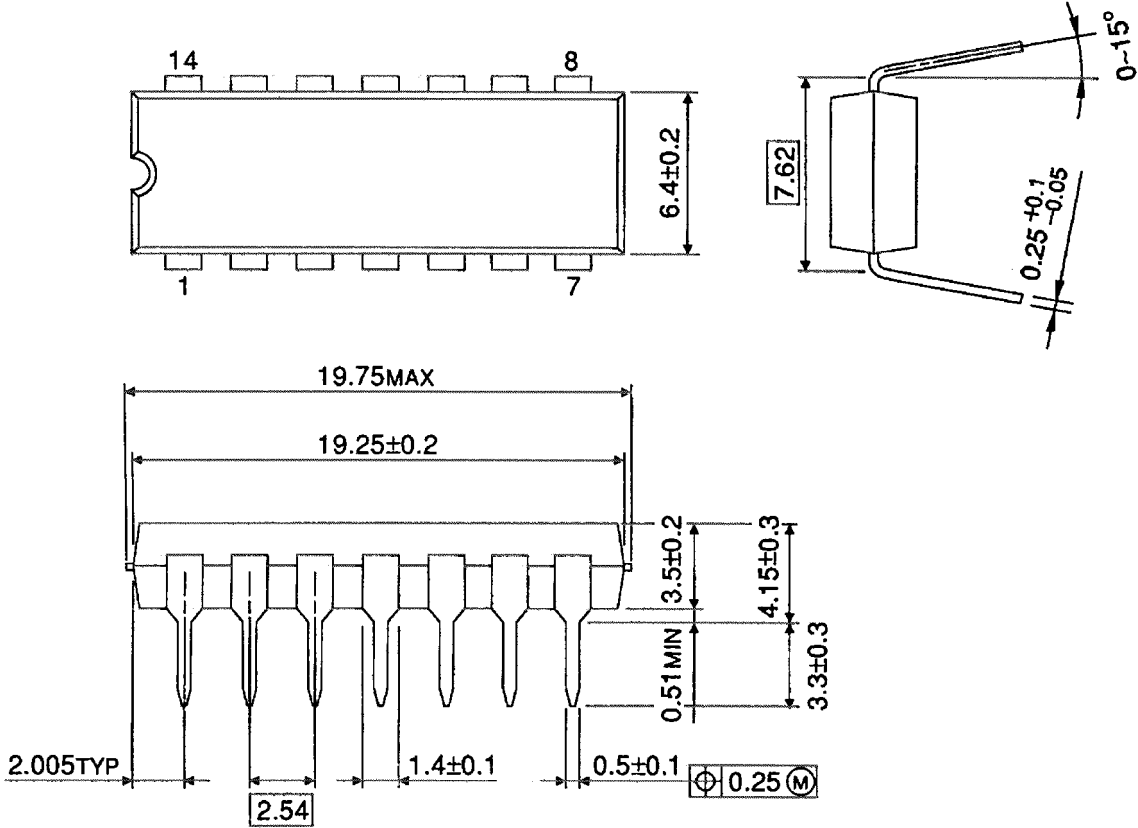
Average operating current can be obtained by the equation:

$$I_{CC} (\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per gate)}$$

**Package Dimensions**

DIP14-P-300-2.54

Unit : mm

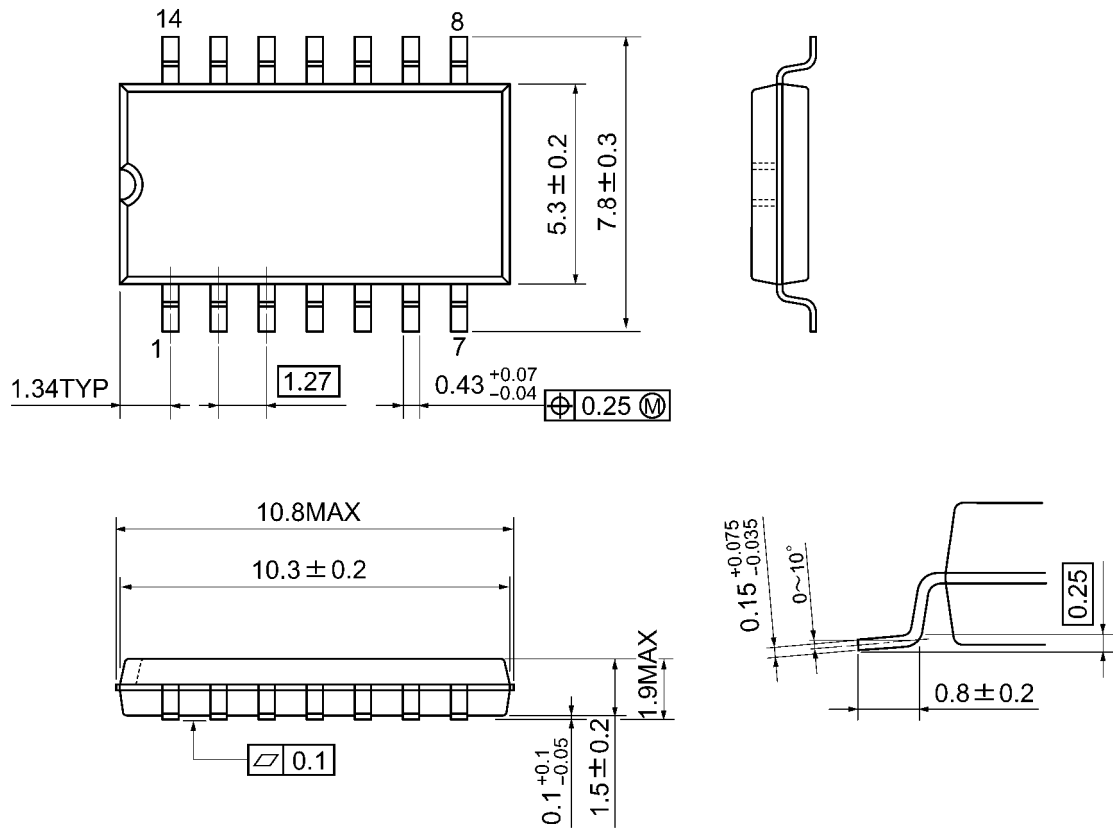


Weight: 0.96 g (typ.)

**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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